IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant:	DAVID J. BAIN, ET AL.	)
		) Group Art Unit: 2836
Serial No.:	10/710,653	)
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Filed:	July 27, 2004	) Examiner: Roman, L.
		)
For:	PRESSURE ASSISTED WAFER HOLDING APPARATUS AND CONTROL METHOD	) Confirmation No.: 4652

AMENDMENT

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

In response to the Office Action mailed March 26, 2007, please amend the Application as follows:

AMENDMENTS TO THE CLAIMS

1. (currently amended) An electrostatic wafer holding apparatus, comprising:

an electrostatic chucking pedestal configured for wafer retention thereupon, said electrostatic chucking pedestal having a plurality of gas channels formed through a top surface thereof;

a bi-directional backside conduit in fluid communication with a backside of said chucking pedestal and said plurality of gas channels;

said bi-directional backside conduit in fluid communication with a backside carrier gas supply line; and

said bi-directional backside conduit further in fluid communication with a vacuum supply line, wherein said plurality of gas channels are configured to facilitate vacuum assisted chucking of a wafer retained on said electrostatic chucking pedestal, wherein the vacuum assisted chucking is implemented prior to performing a wafer processing operation for which the wafer is chucked.

2. (original) The apparatus of claim 1, further comprising means for selectively coupling said bi-directional backside conduit to one of said backside carrier gas supply line and said vacuum supply line.

3. (original) The apparatus of claim 2, further comprising detection circuitry for detecting a curvature present in a wafer placed on said chucking pedestal.

4. (original) The apparatus of claim 3, wherein said detection circuitry is configured to cause said bi-directional backside conduit to be decoupled from said backside carrier gas supply line and coupled to said vacuum supply line upon said detecting a curvature present in said wafer.

5. (original) The apparatus of claim 4, wherein said detection circuitry is

further configured to cause said bi-directional backside conduit to be decoupled from said vacuum supply line and re-coupled to said backside carrier gas supply line upon detecting a desired pressure between said wafer and said chucking pedestal.

6. (currently amended) An electrostatic wafer holding apparatus, comprising:

an electrostatic chucking pedestal configured for wafer retention thereupon, said chucking pedestal having an inner zone and an outer zone, the inner and outer zones each having a top surface disposed beneath a wafer placed on said chucking pedestal;

a bi-directional backside conduit in fluid communication with a backside of said chucking pedestal;

said bi-directional backside conduit in fluid communication with a backside carrier gas supply line; and

said bi-directional backside conduit further in fluid communication with a vacuum supply line;

wherein said inner zone and said outer zone are mechanically decoupled from one another such that the top surface of the outer zone is capable of selective adjustment to positions both below and above the top surface of the inner zone; and

wherein said electrostatic chucking pedestal further comprises a plurality of gas channels formed through a top surface thereof, said plurality of gas channels also in fluid communication with said bi-directional backside conduit, and wherein said plurality of gas channels are configured to facilitate vacuum assisted chucking of a wafer retained on said electrostatic chucking pedestal, and wherein the vacuum assisted chucking is implemented prior to performing a wafer processing operation for which the wafer is chucked.

7. (original) The apparatus of claim 6, further comprising means for selectively coupling said bi-directional backside conduit to one of said backside carrier

gas supply line and said vacuum supply line.

8. (original) The apparatus of claim 7, further comprising detection circuitry for detecting a curvature present in a wafer placed on said chucking pedestal.

9. (original) The apparatus of claim 8, wherein said detection circuitry is configured to cause said bi-directional backside conduit to be decoupled from said backside carrier gas supply line and coupled to said vacuum supply line upon said detecting a curvature present in said wafer.

10. (original) The apparatus of claim 9, wherein said detection circuitry is further configured to cause said bi-directional backside conduit to be decoupled from said vacuum supply line and re-coupled to said backside carrier gas supply line upon detecting a desired pressure between said wafer and said chucking pedestal.

11. (original) The apparatus of claim 6, further comprising a suitable micro-positioning control mechanism associated with each of said inner and outer zones of said chucking pedestal, wherein a height of said inner and outer zones are independently adjustable with respect to one another.

12. (previously presented) The apparatus of claim 11, wherein said outer zone is configured to be in a raised position with respect to said inner zone when a wafer having a positive radius of curvature with respect to said chucking pedestal is placed upon said chucking pedestal.

13. (previously presented) The apparatus of claim 12, wherein said inner zone is configured to be in a raised position with respect to said outer zone when a wafer having a negative radius of curvature with respect to said chucking pedestal is placed upon said chucking pedestal.

14. (currently amended) A method for implementing pressure assisted electrostatic chucking, the method comprising:

placing a wafer onto an electrostatic chucking pedestal;

introducing a supply of backside carrier gas to a backside of said electrostatic chucking pedestal, said electrostatic chucking pedestal having a plurality of gas channels formed through a top surface thereof;

monitoring a pressure between said wafer and said electrostatic chucking pedestal to determine whether a threshold level of chucking force exists; and

decoupling said backside carrier gas from said backside of said electrostatic chucking pedestal and coupling said backside of said electrostatic chucking pedestal to a vacuum supply whenever the actual level of chucking force is less than said threshold level of chucking force, wherein said plurality of gas channels are configured to facilitate vacuum assisted chucking of the wafer wherein the vacuum assisted chucking is implemented prior to performing a wafer processing operation for which the wafer is chucked.

15. (original) The method of claim 14, further comprising introducing a front side supply of gas in conjunction with said vacuum supply.

16. (original) The method of claim 14, further comprising decoupling said vacuum supply from said backside of said electrostatic chucking pedestal and coupling said backside of said electrostatic chucking pedestal to said backside carrier gas whenever the actual level of chucking force meets said threshold level of chucking force.

17. (original) The method of claim 16, further comprising increasing an electrostatic chucking voltage applied to said electrostatic chucking pedestal whenever said coupling of said backside of said electrostatic chucking pedestal to said vacuum supply is insufficient to create said threshold level of chucking force.

18. (original) The method of claim 17, further comprising determining a defective wafer condition whenever said coupling of said backside of said electrostatic chucking pedestal to said vacuum supply is insufficient to create said threshold level of chucking force and said electrostatic chucking voltage exceeds a maximum established value thereof.

19. (previously presented) The apparatus of claim 6, wherein said inner zone is concentrically disposed with respect to said outer zone.

20. (cancelled)

REMARKS

Reconsideration of the instant application is respectfully requested. The present amendment is responsive to the Office Action of March 26, 2007, in which claims 1-20 are presently pending. Of those, claims 1, 2 and 20 have now been rejected under 35 U.S.C. §102(e) as being anticipated by U.S. Patent 5,542,559 to Kawakami, et al. Claims 3-4 are rejected under 35 U.S.C. §103(a) as being unpatentable over Kawakami, in view of U.S. Patent 5,665,166 to Deguchi, et al. Claim 5 is rejected under 35 U.S.C. §103(a) as being unpatentable over Kawakami, in view of Deguchi, in view of U.S. Patent 7,033,443 to Kellerman, et al. (Kellerman '443)

In addition, Claims 6 and 7 have been rejected under 35 U.S.C. §103(a) as being unpatentable over Kawakami, in view of Kellerman '443. Claims 8-10 have been rejected under 35 U.S.C. §103(a) as being unpatentable over Kawakami, in view of Kellerman '443 and Deguchi. Claims 11-13 and 19 have been rejected under 35 U.S.C. §103(a) as being unpatentable over Kawakami, in view of Kellerman '443 and further in view of U.S. Patent Publication 2004/0083975 by Tong, et al. Further, claims 14-17 have been rejected under 35 U.S.C. §103(a) as being unpatentable over Kellerman '443, in view of Kawakami. Finally, claim 18 is rejected under 35 U.S.C. §103(a) as being unpatentable over Kellerman, in view of Kawakami, and further view of U.S. Patent 6,500,686 to Katata, et al. For the following reasons, however, it is respectfully submitted that the application is now in condition for allowance.

In the present amendment, independent claims 1, 6 and 14 have been amended to more particularly point out that, with respect to the vacuum assisted chucking, it is implemented prior to the wafer processing operation for which the wafer is chucked. Support for this amendment is found at least in paragraph [0028] of the specification, as well as in Figure 5 of the drawings. In particular, block 510 of Figure 5 indicates the application of a backside vacuum to implement vacuum assisted chucking. Assuming

sufficient chucking force resulting from the backside vacuum, then wafer processing takes place subsequent to the chucking. In other words, the vacuum assisted chucking is implemented prior to the processing, to ensure sufficient chucking force in the event the wafer is slightly deformed.

In contrast, Kawakami only teaches the use of backside gas evacuation when the chamber is evacuated, in order to prevent positive backside pressure from blowing the wafer of the chuck. That is, the use of reverse backside wafer pressure is only used in Kawakami after the particular processing step (e.g., plasma processing) on the wafer is completed. For example, Kawakami indicates in col. 3, line 66- col. 4, line 35:

"In the plasma treatment apparatus according to the present invention, the backside gas supply means may include supply pump means for supplying a backside gas onto the backside of the object to be treated by way of the gas supply conduit, ***exhaust pump means for exhausting a backside gas from the backside of the object to be treated by way of the gas supply conduit***, exhaust pump means for exhausting a backside gas from the backside of the object to be treated by way of the gas supply conduit, and means for actuating the supply pump means in relation to the operation of the high-frequency electric power supply means and for actuating the exhaust pump means in relation to the completion of the operation of the high-frequency electric power supply means.

By virtue of the above feature, ***a backside gas is exhausted from the backside of the object to be treated after the plasma treatment*** while simultaneously removing water contained in the gas. This lightens the work to remove the backside gas and the water when evacuating the interior of the vacuum treatment chamber.

According to the second aspect of the present invention, there is provided a plasma treatment method comprising the steps of placing an object to be treated on a chuck provided on a lower electrode within a vacuum treatment chamber, and thereby chucking the object; introducing a treatment gas into the vacuum treatment chamber;

supplying a high-frequency electric power between an upper electrode and the lower electrode within the vacuum treatment chamber to produce in the treatment gas a plasma to thereby plasma treat the object; supplying a heat transfer backside gas through the lower electrode to a backside of the object being chucked on the lower electrode, during the plasma treatment; ***exhausting the backside gas from the backside of the object to be treated, after completion of the plasma treatment***; and evacuating the vacuum treatment chamber of the treatment gas." (Emphasis added by Applicant)

As further described in col. 7, lines 4-20 of Katakawa:

"The vacuum treatment chamber 2 is supplied with a treatment gas from the treatment gas supply conduit 23 through the holes in the gas ejection plate 22, while being evacuated by the vacuum pump 24 by way of the exhaust conduit 20 so as to maintain the pressure within the vacuum treatment chamber 2 at a predetermined value. Furthermore, a high-frequency electric power of, for example, 13.56 MHz, 1 KW derived from the high-frequency power source 43 is applied between the upper electrode 21 and the lower electrode 3 to produce a plasma for etching the wafer W. ***Afterwards, the vacuum treatment chamber 2 is evacuated by the exhaust pump 57 by way of the branch conduit 5B of the gas supply conduit 5 so as to prevent the wafer W from being blown off the mount 31 by the pressure of the backside gas remaining within the gas flow path, and then the electrostatic chuck is deenergized.***" (Emphasis added by Applicant)

Accordingly, it will be seen from a review of the Katakawa reference that there is no teaching or suggestion therein that evacuation of backside gas (to create negative pressure or vacuum conditions) is used to assist in the wafer chucking itself prior to the desired process on the wafer. Rather, this is a post-processing step used during evacuation of the chamber gases as a preventative measure for retaining the wafer on the chuck as the treatment chamber gases are evacuated. The electrostatic chuck is then deenergized.

Because, neither Katakawa nor the other references of record teach or suggest that the vacuum assisted chucking, is implemented prior to the wafer processing operation for which the wafer is chucked, it is respectfully submitted that each of the outstanding §102 and §103 rejections have now been overcome.

For the above stated reasons, it is respectfully submitted that the present application is now in condition for allowance. No new matter has been entered and no additional fees are believed to be required. However, if any fees are due with respect to this Amendment, please charge them to Deposit Account No. 09-0458 maintained by Applicants' attorneys.

Respectfully submitted,
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